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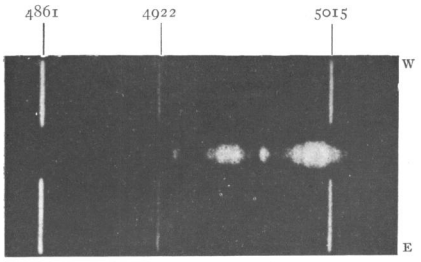

FIG. 1

Spectrogram of *Nova Aquilae*, August 1, 1919
Slit in position angle 112°

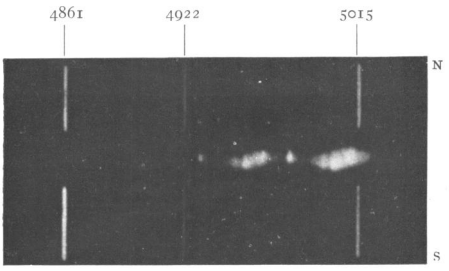

FIG. 2

Spectrogram of *Nova Aquilae*, August 1, 1919
Slit in position angle 202°

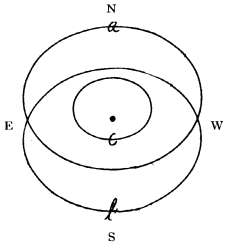

FIG. 3

a. *Nova* image in 5012 A.
b. *Nova* image in 5002 A.
c. *Nova* image in 4978 A.

PLATE IX.

THE GREEN NEBULAR BANDS IN NOVA AQUILAE No. 3

By J. H. Moore and C. D. Shane

During the months of July, August, and September we have secured a number of spectrograms of *Nova Aquilae* No. 3, with spectrographs of one-prism and three-prism dispersion attached to the 36-inch refractor. As the image of the nova is a small greenish disk about two inches in diameter, an opportunity was offered to test this object for evidences of internal motion and for varying distribution of emitted light. For this purpose it was necessary to hold the image of the nova fixed on the slit during the exposure instead of allowing it to drift along the slit as is usually done with the stellar objects. The first two spectrograms secured in this manner were obtained on July 22nd with one-prism spectrographs respectively in the visual and photographic regions. On both of these the nova bands N_1 and N_2, or those whose centers coincide approximately with the nebulium lines 5007A and 4959A, extend on either side of the narrow continuous spectrum at least twice as far as the bands at Hα, 5755, Hβ, 4660, 4363, Hγ, and Hδ. Evidently the greenish nova disk is due chiefly to these two nebular bands. Unfortunately, on these two plates the form of the N_1 and N_2 bands was seriously affected by the chromatic aberration of the 36-inch objective. On the spectrogram taken with the visual spectrograph, N_1 and N_2 suffered much less from this disturbance, and on this plate the nebular bands have a peculiar form the real nature of which was clearly indicated by Professor Wright's observations secured a few nights later with a slitless spectrograph and the Crossley reflector.

Mr. Wright's observations, altho obtained with much lower dispersion than that used by us, enabled him to study this effect in all of the nova bands from 3346 to 5007A. The results of his interesting investigation have been described by him in *Lick Observatory Bulletin* No. 322. In this same number of the *Bulletin* we have given the results of our detailed study of the effect of the N_1 and N_2 nebular bands, as shown on our spectrograms obtained with one-prism dispersion. As our observations have been confined for the most part to N_1 and N_2, the slit was placed in the focus of the objective for rays of wave-length intermediate between those of the two nebular bands.

In Plate IX, figures (1) and (2), are reproduced two of our one-prism spectrograms (each 30 minutes exposure) of August 1, 1919, a comparison of which shows the peculiar form of the N_1 and N_2 bands, observed along two particular axes of the nova image at right angles to each other. The plate of figure (1) was secured with the slit across the nova image in position angle 112°. In this case the two bands present the general form and appearance of those observed in previous novae at this stage of their development and in particular in the present one as described by Messrs. Adams and Joy.[1] In figure (2), however, for which the slit was placed across the nova disk in position angle 202°, the two bands have a sinuous form which may be likened roughly to a capital S placed horizontally along the direction of the spectrum. These two plates represent respectively the minimum and maximum effects of the sinuous form. The directions in which the slit should be set across the nova image in order to obtain them were determined from Mr. Wright's slitless spectrograms and our plates taken with the slit placed in a number of position angles.

The vacuum tube spectra of hydrogen and helium were photographed on each plate for comparison. In the illustration the $H\beta$ (4861A) line of hydrogen and the two helium lines 4922A and 5015A are indicated. The two nebular bands N_1 (one on the right in illustration) and N_2 are some 50 or 60A in width and in consequence overlap slightly. As they are quite faint in the region where overlapping occurs they appear fairly well separated on plates of short exposure. They are quite similar in structure, but N_1 is much stronger than N_2. Each band consists of a strong central portion some 30A in width accompanied by outlying appendages, of which the most conspicuous is the strong narrow maximum situated 29A to the violet of the center of the band. The section whose width is about 30A shows a marked increase in intensity in its central portion some 10A in width, which in turn is divided into several maxima and minima.

We have recently obtained several spectrograms of the nova with a three-prism spectrograph set for minimum deviation in the region of the nebular bands. These show a still more complicated structure of the maxima and minima in N_1 and N_2 than those given by our one-prism plates. A detailed discussion of these results will be published later.

[1] *Pub. Astr. Soc. Pac.*, **31**, 182, 1919.

The sum of measured distances to which the nova spectrum extends on each side of the center of the continuous spectrum, when reduced to seconds of arc by means of the known constants of the 36-inch telescope and spectrograph, gives the corresponding value of the diameter of the nova disk. From our measures we have subtracted the width of the continuous spectrum of the stellar nucleus in an effort to eliminate effects due to the chromatic aberration of the 36-inch lens, the astigmatism of the prisms, and the unavoidable drifting of the image on the slit. Owing to the faintness of the continuous spectrum on our plates, it appears probable that the effects of these sources of error have not been completely removed from our results.

The mean diameters of the nova disk as shown by our measures are as follows:

[1]N_1	3″.0	one-prism
	2″.6	three-prism
N_2	2″.2	one-prism
	1″.8	three-prism
$H\beta$	1″.0	one-prism

The measure of the $H\beta$ band was made on a spectrogram for which the slit was placed in the focus of the objective for the $H\beta$ rays. This spectrogram was obtained with the slit in position angle 202° and the $H\beta$ band shows the same form as that given by N_1 and N_2 in this position. Mr. Wright has shown that this same form characterizes all of the nova bands from 3346 to 5007A, but that the disks corresponding to the hydrogen radiations are only slightly larger than that of the central stellar nucleus.

The obvious interpretation of the form of the bands obtained in the various positions of the slit is that different wave-lengths have their origin in different parts of the nebula. Referring to the spectrogram obtained with slit along the axis in position angle 202°, figure 2, the strong maxima in N_1 at 5012A and 5002A have their origins respectively in the northern and southern portions of the disk. Similarly the origin of the portion of the band 5030-5040A, while in the central region of the nova, lies wholly south of the center of the disk. The maximum 4978A at the more refrangible edge of the N_1 band also originates in the central part of the disk, but in a region for the most part north of the stellar nucleus. In figure 3 we have drawn the approximate elliptical disks which are

[1]Mr. Wright, from his slitless plates obtained the mean diameter of the nova disk corresponding to N_1 and N_2 as 2″, and for 4363 a diameter of 1″.

the sources of the radiations in the N_1 band at 5012, 5002, and 4978A, denoted respectively by the small letters *a*, *b*, and *c*. The source of the continuous spectrum is represented by the small dot at the center.

An examination of our one-prism spectrograms and one obtained with three-prism dispersion (slit in position angle 146°) for evidence of inclination of the detailed structure of the bands, either the maxima or minima, failed to indicate the presence of such an effect on these plates. Spectrograms which we have obtained later with a three-prism spectrograph, and with the slit in position angle 112°, indicate, however, that the maxima and minima in the strong central section of the N_1 and N_2 (some 10A in width) show an average inclination of nearly 10° with respect to the zero direction as given by the comparison lines and in the sense that the portion of line originating in the western part of the nova is displaced toward the red. The inclination is not the same for all the maxima and minima, and in the outer portions of the band there are examples of no inclination and a few examples where the lines appear slightly inclined in the opposite direction. The phenomenon appears to be a very complex one. On the spectrograms obtained with the slit in position angle 202° or those on which the maximum sinuous effect is shown in the form of the bands, little or no inclination appears to be shown by the detailed structure. It is interesting to note that the maximum inclination of the internal structure of the bands is obtained when the slit is placed parallel to the major axes of the elliptical images drawn in figure 3. Altho this is the spectrographic effect to be expected from a rotating ellipsoid, the phenomenon may be due to some other cause.

Observations which we have secured for the purpose of testing for the presence of plane polarization in the portion of the bands originating at the north and south edges of the disk appear to be conclusive in showing that the observed form of N_1 and N_2 is not due to the presence of plane polarized light, but is a real effect in the nova itself.